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NEW RESULTS ON THE LASER PRODUCED RELATIVISTIC ELECTRON-POSITRON PAIR PLASMA RESEARCH

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Following initial experiments that produced the high-flux jets of positrons with temperatures of MeV using high-intensity laser facilities [1], we have performed a series of experiments exploring unique characteristics of pair jets and plasmas from the energetic short-pulse lasers on the Titan and OMEGA EP [2] as well as the Osaka LFEX [3] and AWE Orion laser facilities. These experiments focused on the topics of understanding the pair production scaling and collimation. The experiments were performed over a large range of laser parameters including the intensity (10^18 – 10^21 Watts/cm^2), contrast (10^6 – 10^9), and energy (100 – 2000 J). We measured the positron beam emittance to be 100 – 500 mm.mrad, comparable to that used in Stanford Linear Collider [2]. The laser contrast was found to have a large effect to the positron yield [3]. The scaling of pair production vs laser energy has been confirmed to be nonlinear when the laser energy is greater than 1000 J [4]. We found significant effect of the laser intensity to the pair production using Orion and OMEGA EP laser. We have started to explore the pair jet collimation using electromagnetic fields. We aim to use the multi-kilojoule, short-pulse laser systems worldwide in combination with more advanced target designs to create the first relativistic high-density pair plasmas in the laboratory - a completely novel system enabling detailed study of some of the most exotic and energetic systems in the universe [5].

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[4] Chen, H., Meyerhofer, D. D., Sentoku Y. *et al.*, in preparation.
[5] Rosner, R. *et al.*, "Research Opportunities in Plasma Astrophysics" (2010); Also see Betti, R., *et al.* "Advancing the Science of High Energy Density Laboratory Plasmas" (2009)